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(54) **Collapsible ladder.**

(57) A ladder including first and second leg elements, a plurality of treads, and pivot means coupling the plurality of treads to each of the leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements, the first leg element being arranged for selectable slideable motion with respect to the treads and the second leg element.

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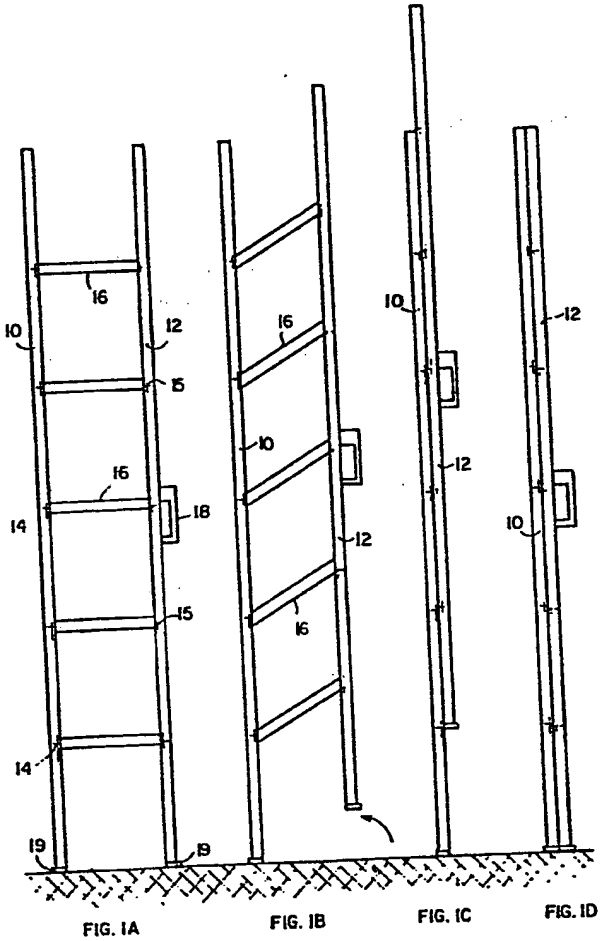

FIG. 1A FIG. 1B FIG. 1C FIG. 1D

FIG. 1E

COLLAPSIBLE LADDER

The present invention relates to collapsible ladders.

A wide variety of ladders and step stools are known on the market today. The most common ladders comprise a front portion defining a plurality of treads and a rear portion pivotably affixed at the top to the front portion and which opens out to stabilize the ladder. For transportation, the rear portion is pivoted to lie adjacent the front portion and the ladder is carried to the desired location. Due to the length and width of the ladder, this is generally a cumbersome procedure.

Extension ladders also exist on the market. These consist of two ladder units, each defining a plurality of treads, which are slideably affixed to one another. In use, one unit slides lengthwise along the second to the fully extended position where it is locked to the second. For purposes of transportation, the lock is released and the first unit slides along the second until the two units are adjacent one another. Such ladders are also quite cumbersome to carry.

Step stools are known which comprise a front and a rear portion including upstanding legs having rotatably mounted thereon a number of treads. When it is desired to move the step stool, it can be folded by pivoting the rear portion to lie adjacent the front portion which causes the treads to rotate and to lie in a plane parallel to the legs.

Accordingly, it is an object of the present invention to provide a ladder which is simple to manufacture and which can be collapsed to an easily portable size and shape.

There is thus provided in accordance with the present invention a ladder including first and second leg elements, a plurality of treads, and pivot means coupling the plurality of treads to each of the leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements, the first leg element being arranged for selectable slideable motion with respect to the treads and the second leg element.

There is further provided, in accordance with a preferred embodiment of the present invention, a ladder including a front portion including a first and second leg element, a plurality of treads, pivot means coupling the plurality of treads to each of the leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements, and a rear portion pivotably coupled to the front portion and including third and fourth leg elements, at least one support member, and pivot means coupling the at least one support

member to each of said leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axis of the support member is perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axis of the support member is parallel to the longitudinal axes of the leg elements, the first leg element being arranged for selectable slideable motion with respect to the treads and the second leg element and the third leg element being arranged for selectable slideable motion with respect to the treads and the fourth leg element.

Further in accordance with a preferred embodiment of the invention, each of the treads defines two parallel grooves extending along the length thereof and the ladder additionally includes a plurality of sliding pins affixed to the first leg element, two corresponding to each of the treads, the pins being seated in the groove of the corresponding tread for selectable sliding therealong.

Still further in accordance with a preferred embodiment, the support member defines two parallel grooves along the length thereof and the ladder further includes at least two sliding pin means affixed to the third leg element corresponding to the support member and seated for slideable movement in the parallel grooves of the corresponding support member.

Additionally in accordance with a preferred embodiment, the second leg element includes a plurality of fixed pins, each corresponding to one of the plurality of treads, and each of the treads is pivotably coupled about the corresponding fixed pin.

Still further in accordance with a preferred

embodiment, there is additionally provided selectable locking apparatus for retaining the ladder either in its collapsed orientation or its expanded orientation.

There is additionally provided in accordance with the present invention a ladder including first and second legs and a plurality of treads pivotably mounted on the legs, the ladder being arranged to selectably assume at least three orientations, a first, expanded orientation wherein the longitudinal axes of the treads lie perpendicular to the longitudinal axes of the legs, a second, partially collapsed orientation wherein the first and second legs lie adjoining one another in overlapping relationship and the longitudinal axes of the treads lie parallel to the longitudinal axes of the legs, and a third, completely collapsed orientation wherein the first and second legs lie contiguous to one another along their entire length.

The present invention will be further understood and appreciated from the following detailed description taken in conjunction with the drawings in which:

Figs. 1A, 1B, 1C and 1D are front view illustrations of a ladder constructed and operative in accordance with the present invention in respective fully expanded, partially expanded, partially collapsed and fully collapsed orientations;

Fig. 1E is a top view cross-sectional illustration of the ladder of Fig. 1D in the fully collapsed orientation;

Fig. 2A is an illustration of a ladder constructed and

operative in accordance with a preferred embodiment of the invention;

Fig. 2B is a side view illustration of the ladder of Fig. 2A in an open orientation;

Fig. 2C is a side view illustration of the ladder of Fig. 2A in a closed orientation;

Fig. 3 is a cut away illustration of the coupling mechanism of the front and back portions of the ladder ofFigs. 2A-2C;

Fig. 4A is a front view detail illustration of a tread of a ladder constructed and operative in accordance with an embodiment of the present invention;

Fig. 4B is a partially cut away top view illustration through line B-B of the tread of Fig. 4A;

Fig. 4C is a partially cut away side view illustration through line C-C of the tread of Fig. 4B;

Figs. 5A and 5B are partially cut away front view detail illustrations of a ladder constructed and operative in accordance with an embodiment of the present invention in respective partially collapsed and fully collapsed orientations; and

Figs. 6A and 6B illustrate a locking mechanism for a ladder constructed in accordance with the present invention in respective expanded and collapsed orientations.

With reference to Figs. 1A, 1B, 1C and 1D there is shown a collapsible ladder constructed and operative in

accordance with the present invention in a number of orientations. The ladder comprises a first leg element 10 and second leg element 12. According to a preferred embodiment, leg elements 10 and 12 have a three sided, hollow rectangular configuration and may be constructed of any suitable material, preferably aluminum.

A plurality of treads 16 are pivotably mounted on leg elements 10 and 12 about pivot axes 14 and 15, which will be described in detail hereinbelow. The ladder may additionally comprise a handle 18 for ease of transportation and foot elements 19 for stabilizing the ladder on the earth. The handle 18 may include a locking mechanism, as further discussed hereinbelow.

Fig. 1A shows the ladder in its fully expanded orientation for climbing. In this orientation, the longitudinal axis of the treads lies perpendicular to the longitudinal axes of the leg elements, as in conventional ladders.

When it is desired to collapse the ladder, as shown in Fig. 1B, leg element 12 is lifted in the direction of the arrow relative to leg element 10 causing treads 16 to pivot about pivot axes 14 and 15 relative to both leg elements 10 and 12. Continued lifting of leg element 12 and consequent pivoting of treads 16 brings the ladder to the partially collapsed orientation of Fig. 1C.

It is a particular feature of the present invention, that when the ladder is collapsed, treads 16 pivot to lie between and within leg elements 10 and 12, their longitudinal axes parallel to the longitudinal axes of the leg elements. This is

due to the hollow structure of the leg elements and the nature of the pivot mechanisms.

To completely collapse the ladder, leg element 12 now slides downwardly alongside leg element 10 to yield a compact, easily portable product whose dimensions are the length and width and depth of two adjacent leg elements only as shown in cross section in Fig. 1E. This sliding capability is a particular feature of the present invention and will be described in further detail hereinbelow.

With reference to Figs. 2A, 2B and 2C there is shown a ladder constructed and operative in accordance with an alternate embodiment of the invention. It comprises a front portion, generally designated 20, and a rear portion 30. Front portion 20 comprises first and second leg elements 22 and 24 and a plurality of treads 26 pivotably mounted on leg elements 22 and 24. The ladder may be provided with a pair of engagement elements 28, fixedly mounted atop each of leg elements 22 and 24. Engagement elements 28 are generally trapezoidal in shape and serve to retain the ladder in engagement with the wall against which it is leaning. Leg elements 22 and 24 may also be provided with foot elements 29 which serve to balance the ladder on the ground.

Rear portion 30 comprises third and fourth leg elements 32 and 34 and at least one support element 36 pivotably mounted on the leg elements. Support elements 36 provide support and stability for the ladder in its expanded orientation and may comprise treads to permit mounting of the ladder from both sides. According to a preferred embodiment, the rear portion includes two support elements, one near the top of the rear portion to

strengthen the pivotal connection to the front, and a lower element to support the ladder in its expanded orientation. Support elements 36 are identical in construction to treads 26.

Additionally, a chain 37 may be provided for additional security and support against collapse of the ladder under weight.

It is a particular feature of the present invention that the pivot mechanisms of both front portion 20 and rear portion 30 are substantially similar to that of the ladder of Figs. 1A-D. Thus, the ladder is closed by pivoting rear portion 30 to lie along front portion 20, then the front and rear portions pivot simultaneously about their respective treads and support members and the ladder of Figs. 2A-C collapses in a manner analogous to that of the ladder of Figs. 1A-1D to a compact, easily portable unit.

Rear portion 30 is pivotably coupled to front portion 20 at a point along each of leg elements 22 and 24 where there is no tread. It will be noted that leg elements 32 and 34 of rear portion 30 define slanted top surfaces 40 which are arranged for supporting engagement with the rear surface of leg elements 22 and 24 when the ladder is in its open orientation.

Any conventional hinge mechanism is operative to join the leg elements of rear portion 30 to those of front portion 20. One suitable hinge mechanism is illustrated in Fig. 3. It will be appreciated that, while the hinge is described with reference to legs 24 and 34, an identical hinge mechanism couples legs 26 and 36. The hinge comprises a first plate 42 affixed to front leg 24 as by a bolt 44 and defining an integrally formed cylinder 46,

and a second plate 48 affixed to rear leg 34 as by a bolt 50 and defining an integrally formed cylinder 52 (not shown). Cylinders 46 and 52 are coupled as by means of a pin 54 whereby cylinder 52 and leg 34 pivot about pin 54 from the open orientation of Fig. 2B to the closed orientation of Fig. 2C. Preferably, a recess 56 is provided in leg 24 for receiving the head of bolt 50 to permit closing of the leg 24 flush with leg 34.

Referring to Figs. 4A, 4B and 4C, there is shown in detail tread pivot mechanism for a ladder constructed and operative in accordance with a preferred embodiment of the invention. As can be seen in respective front and cut away top view illustration in Figs. 4A and 4B, the ladder comprises a first leg element 60 and a second leg element 62 onwhich are pivotably mounted a plurality of treads 64. Tread 64 defines two grooves 66 defining shoulders 67 which serve as tracks along the length of the tread. Tread 64 also defines an angled corner 68 which permits pivoting of the tread without interference with leg element 60.

Tread 64 is pivotably mounted on leg element 60, as about a fixed pin 70. Fixed pin 7C permits free pivoting of tread 64 between the expanded and the collapsed orientations. Any other pivoting mechanism which permits this pivoting motion may alternatively be used.

Tread 64 is pivotably mounted onto leg element 62 about two sliding pins 72. Sliding pins 72 comprise an interior portion 74, defining a retaining disk 75, which is seated within groove 66 and retained therein by shoulders 67 and is arranged for sliding along the length of the groove. Stop elements, such as

screws 76, may be provided to prevent sliding pins 72 from disengaging completely from grooves 66 at the edge of the tread.

Operation of the ladder of the present invention will now be described with further reference to Figs. 4A - C and reference to Figs. 5A and 5B which illustrate the ladder tread of Figs. 4A-C in respective partially and fully collapsed orientations. When it is desired to collapse the ladder, leg 62 is raised relative to leg 60, causing tread 64 to pivot in a counterclockwise direction about fixed pin 70. At the same time, tread 64 also pivots in a counter-clockwise direction about sliding pins 72, until the longitudinal axis of the tread lies parallel to the longitudinal axis of the leg elements and the two leg elements lie flush to one another along most of their length, as shown in Fig. 5A. In this orientation, pins 72 are positioned adjacent stop members 76. (This orientation corresponds to that shown in Fig. 1C.)

In order to fully collapse the ladder, leg element 62 slides lengthwise along leg element 60. As leg element 62 moves, sliding pins 72 slide along grooves 66 until the two leg elements are coextensive. (This fully collapsed orientation corresponds to Fig. 1D.) The ladder can now be easily transported to any desired location where it may be expanded once again by reversing the above procedure.

The ladder of the present invention is preferably provided with a locking mechanism to retain the ladder in either or both of its expanded and collapsed orientations. With reference to Figs. 6A and 6B, there is shown one locking

mechanism suitable for use with the collapsible ladder of the present invention. The locking mechanism is mounted on carrying handle 80 affixed to a first leg element 82. Pivotably mounted between first leg element 82 and a second leg element 84, adjacent the handle, is a tread 86.

The locking mechanism itself comprises a spring biased member 90 defining an actuator 92, and a locking finger 94. Locking finger 94 is seated for slideable motion within a groove 95 in handle 80. Member 90 is pivotably mounted about a mounting pin 96 and is arranged to be tensioned by means of a spring 98 upon actuation of actuator 94.

Leg element 82 is provided with an aperture 100 adjacent locking finger 94 through which locking finger 94 protrudes in its locking orientation (as illustrated). Tread 86 also defines an aperture 102 into groove 87 of the tread. Locking finger 94 protrudes through aperture 102 when the ladder is in its fully collapsed orientation, as shown in Fig. 6B. Locking finger 94 thus serves to prevent sliding movement of leg 82 relative to tread 86 by preventing the sliding pins from moving along groove 87. In effect, locking finger 92 acts as a releasable stop element. Tread 86 may be provided with an additional aperture 104 to prevent inadvertent engagement of locking finger 94 during collapsing of the ladder.

Handle 80 defines a cylindrical aperture 106 adjacent locking mechanism 90. A pin or other retaining means (not shown) may be inserted into aperture 106, the anterior portion thereof protruding from aperture 106 and abutting actuator 92. The retaining means serves to prevent actuation of the locking

mechanism and consequent opening of the ladder in the event that an object inadvertently falls onto the actuator 92.

When it is desired to expand the ladder, manual pressure, such as by the thumb of the operator, on actuator 94 causes locking member 90 to pivot in a clockwise direction about mounting pin 96 causing locking finger 94 to slide outwardly along groove 95, thereby withdrawing locking finger 92 from apertures 102 and 100 in the tread and leg element and tensioning spring 98. Leg element 82 can now slide relative to leg element 84 and tread 86 along the length of groove 87. Leg element 82 is then moved apart from leg element 84 and the treads 86 pivot into the fully expanded orientation. The tension of spring 98 returns the locking member 90 to its locking orientation when actuator 94 is released. When the ladder is fully expanded, as illustrated in Fig. 6A, locking finger 94 protrudes through aperture 100 in leg element 82 and rests on tread 86. This serves to prevent tread 86 from pivoting in a counter-clockwise direction and inadvertently collapsing the ladder.

It will be appreciated that any other locking mechanism may alternatively be employed which will prevent inadvertent collapse of the ladder during use. Another example of a suitable locking mechanim is the mounting of a flexible polymeric material or polyurethane stopper element onto the ends of the treads 86 which are slideable affixed to leg element 82. Such a material, having a high coefficient of friction, would act to wedge the tread against the leg element when in the fully expanded orientation of Fig. 6A and require a certain force to be exerted

to release the treads when the ladder is to be collapsed.

It will be appreciated by those skilled in the art that the invention is not limited to what has been shown and described hereinabove by way of example. Rather, the scope of the invention is limited solely by the claims which follow.

CLAIMS

1. A ladder comprising:

first and second leg elements;

a plurality of treads; and

pivot means coupling said plurality of treads to each of said leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements;

said first leg element being arranged for selectable slideable motion with respect to the treads and the second leg element.

2. A ladder comprising:

a front portion comprising:

first and second leg elements;

a plurality of treads; and

pivot means coupling said plurality of treads to each of said leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements; and

a rear portion pivotably coupled to the front portion and comprising:

third and fourth leg elements;

at least one support member; and

pivot means coupling said at least one support member to each of said leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axis of the support member is perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axis of the support member is parallel to the longitudinal axes of the leg elements;

said first leg element being arranged for selectable slideable motion with respect to the treads and the second leg element and said third leg element being arranged for selectable slideable motion with respect to the treads and the fourth leg element.

3. A ladder according to either of claims 1 and 2 and wherein each of said treads defines two parallel grooves along the length thereof; and further comprising:

a plurality of sliding pin means affixed to said first leg element, two corresponding to each of said treads and seated for slideable movement in the parallel grooves of the corresponding tread.

4. A ladder according to either of claims 2 and 3 and wherein said at least one support member defines two parallel grooves along the length thereof; and further comprising:

at least two sliding pin means affixed to said third leg element corresponding to said at least one support member and seated for slideable movement in the parallel grooves of said

corresponding support member.

5. A ladder according to any of the preceding claims and wherein said second leg element comprises a plurality of fixed pin means, each corresponding to one of said plurality of treads;

each of said treads being pivotably coupled about the corresponding fixed pin means.

6. A ladder according to any of the preceding claims and further comprising selectable locking means for retaining the ladder in its collapsed orientation.

7. A ladder according to any of the preceding claims and further comprising selectable locking means for retaining the ladder in its expanded orientation.

8. A ladder comprising:

first and second leg elements;

a plurality of treads, each of said treads defining two parallel grooves along the length thereof;

a plurality of sliding pin means affixed to said first leg element, two corresponding to each of said treads and seated for slideable movement in the parallel grooves of the corresponding tread; and

pivot means coupling said plurality of treads to each of said leg elements for selectable pivoting from an operative orientation, wherein the longitudinal axes of the treads are perpendicular to the longitudinal axes of the leg elements, to a collapsed orientation, wherein the longitudinal axes of the treads are parallel to the longitudinal axes of the leg elements.

9. A ladder according to claim 8 and wherein said second leg element comprises a plurality of fixed pin means, each corresponding to one of said plurality of treads;

each of said treads being pivotably coupled about the corresponding fixed pin means.

10. A ladder comprising:

first and second legs; and

a plurality of treads pivotably mounted on the legs;

said ladder being arranged to selectably assume at least three orientations:

a first, expanded orientation wherein the longitudinal axes of the treads lie perpendicular to the longitudinal axes of the legs;

a second, partially collapsed orientation wherein the first and second legs lie adjoining one another in overlapping relationship and the longitudinal axes of the treads lie parallel to the longitudinal axes of the legs; and

a third, completely collapsed orientation wherein the first and second legs lie contiguous to one another along their entire length.

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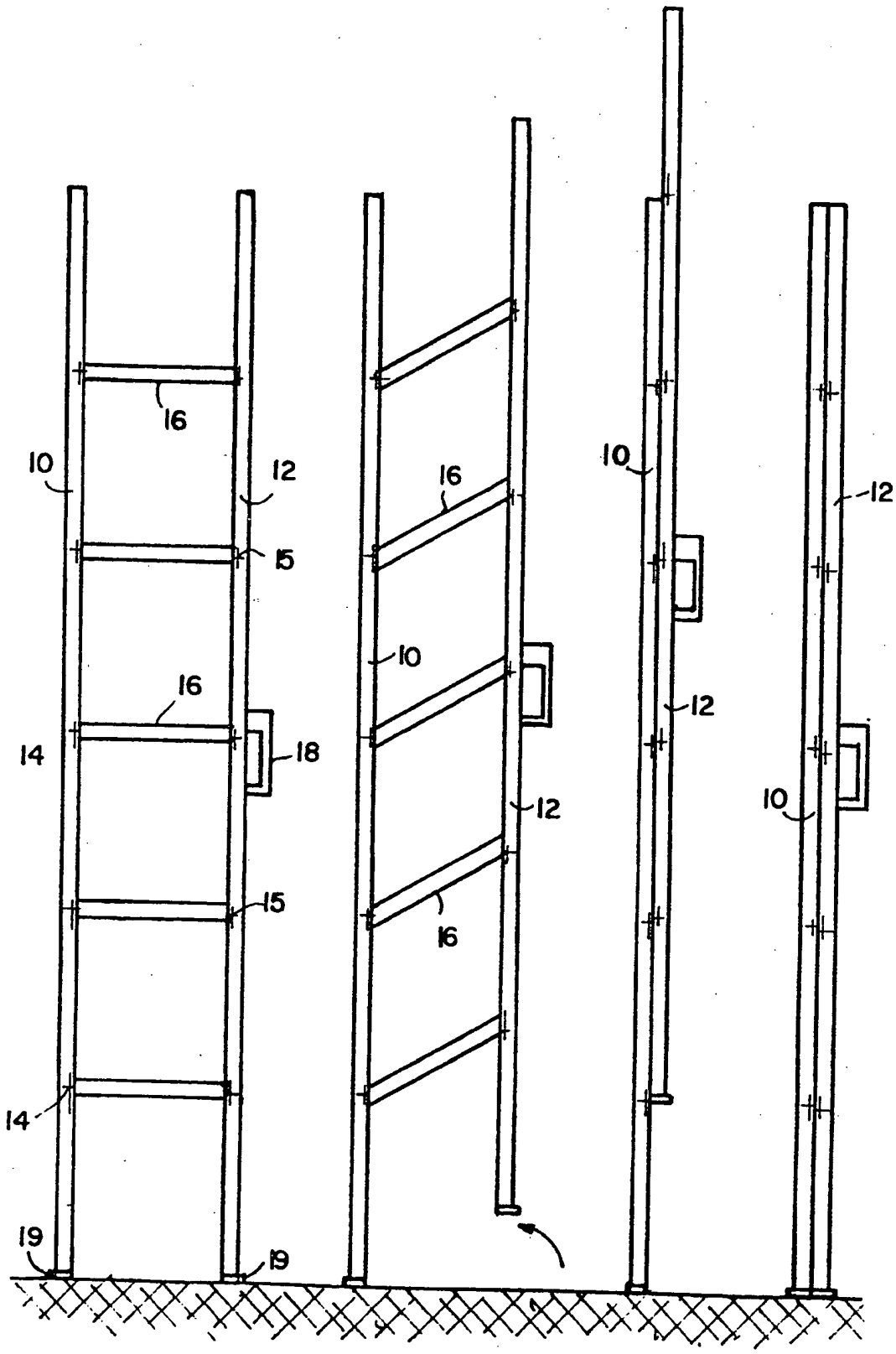

FIG. 1A FIG. 1B FIG. 1C FIG. 1D

FIG. 1E

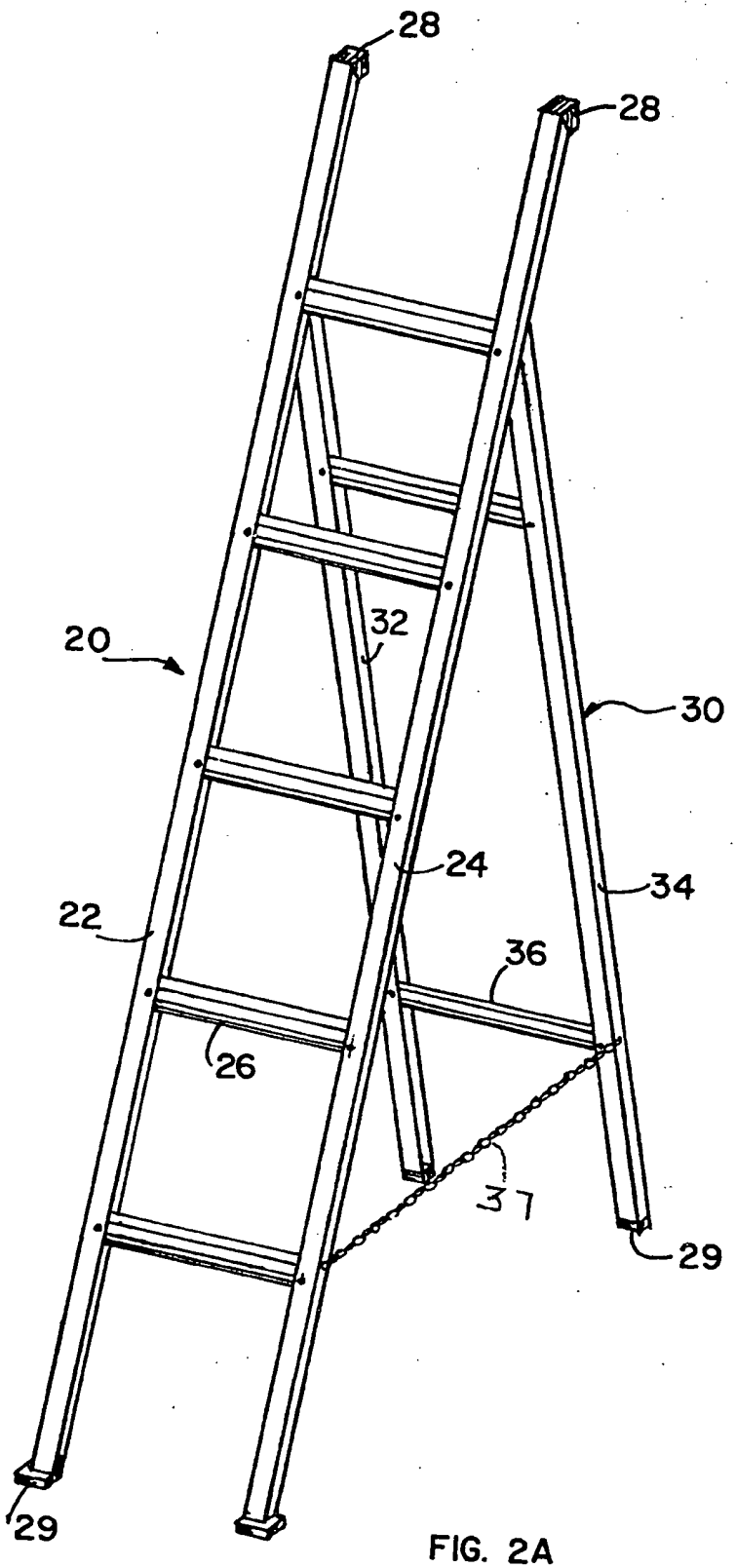

FIG. 2A

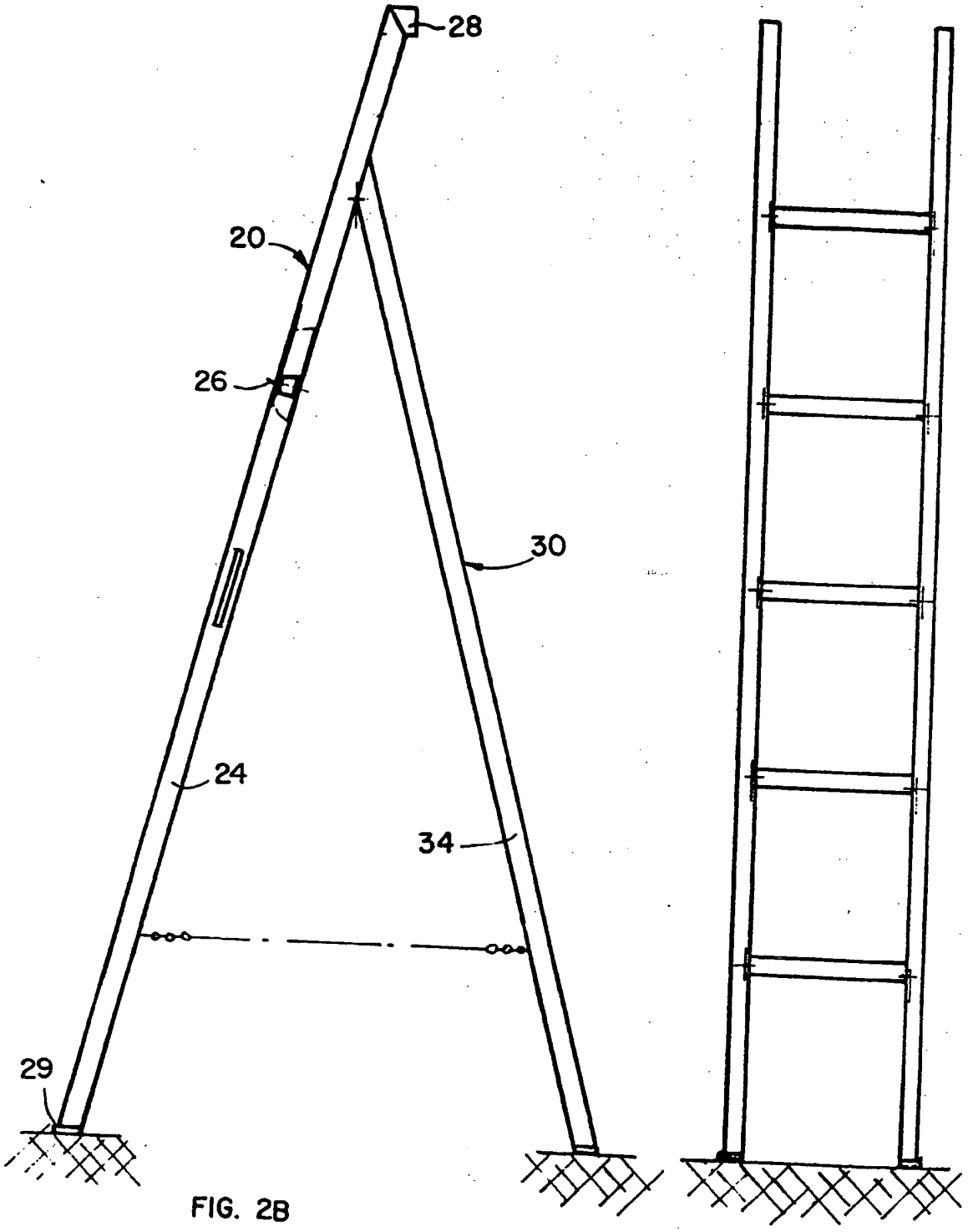

FIG. 2B

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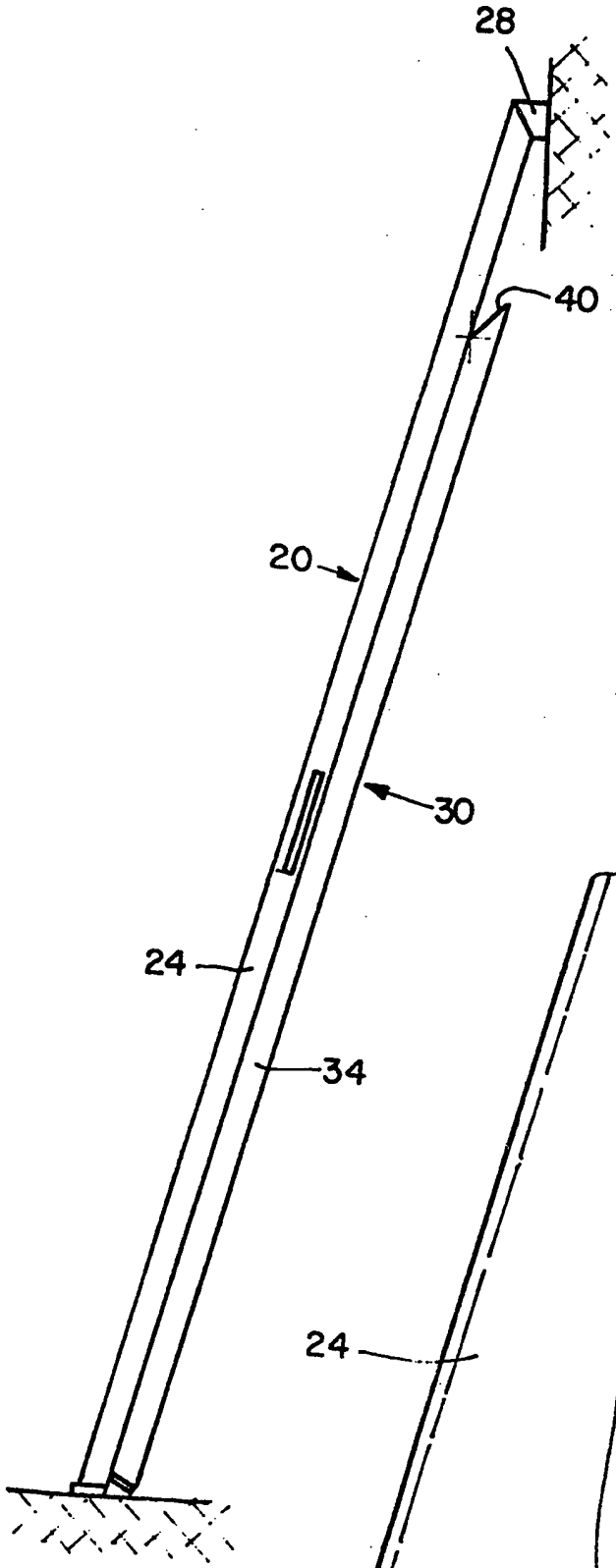

FIG. 2C

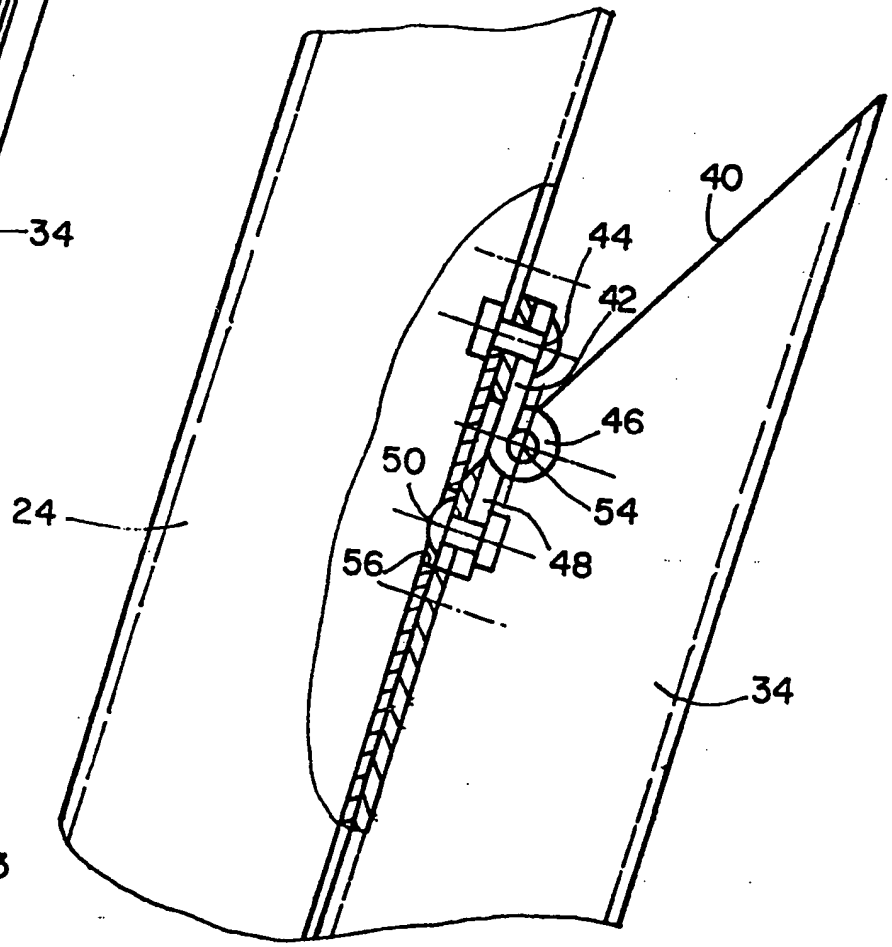

FIG. 3

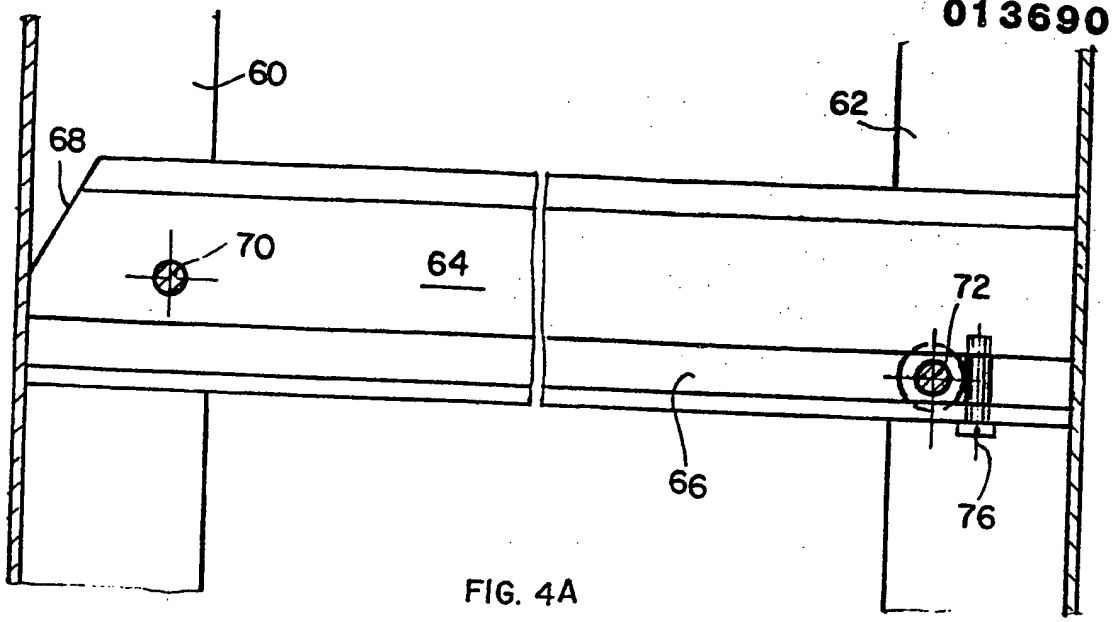

FIG. 4A

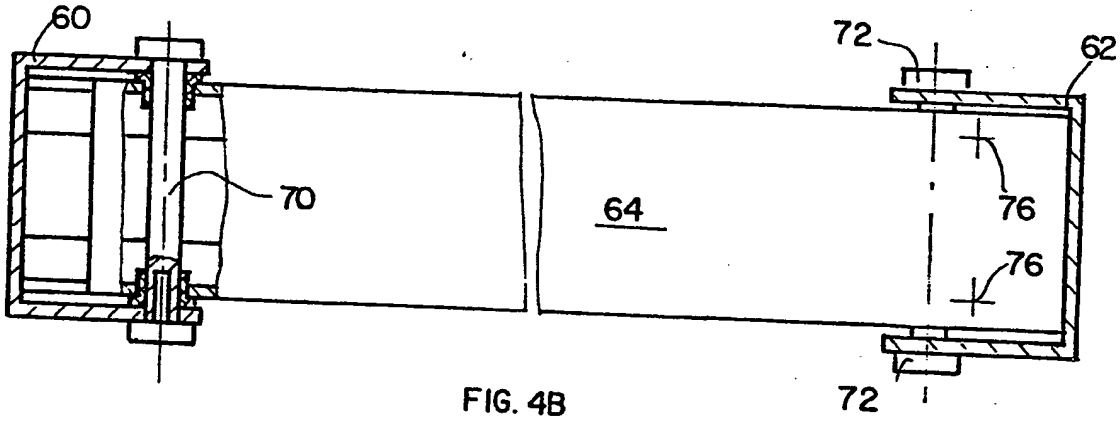

FIG. 4B

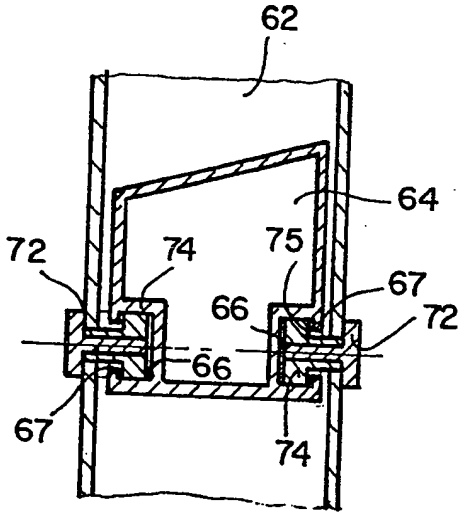

FIG. 4C

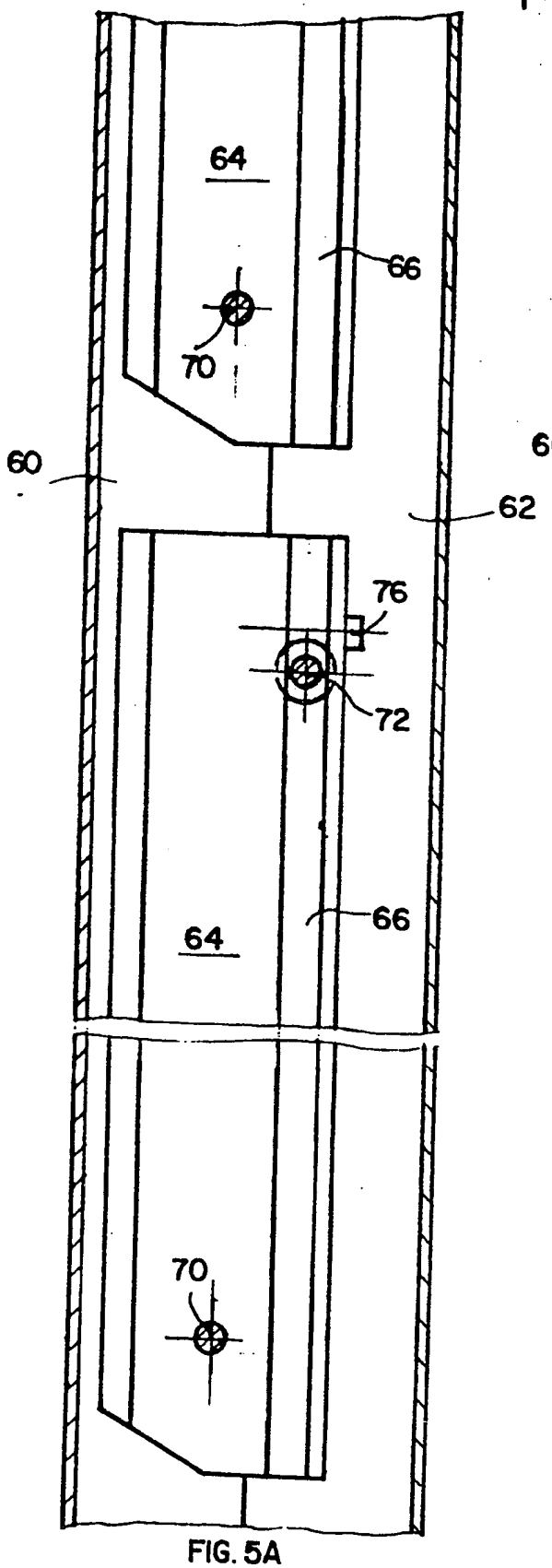

FIG. 5A

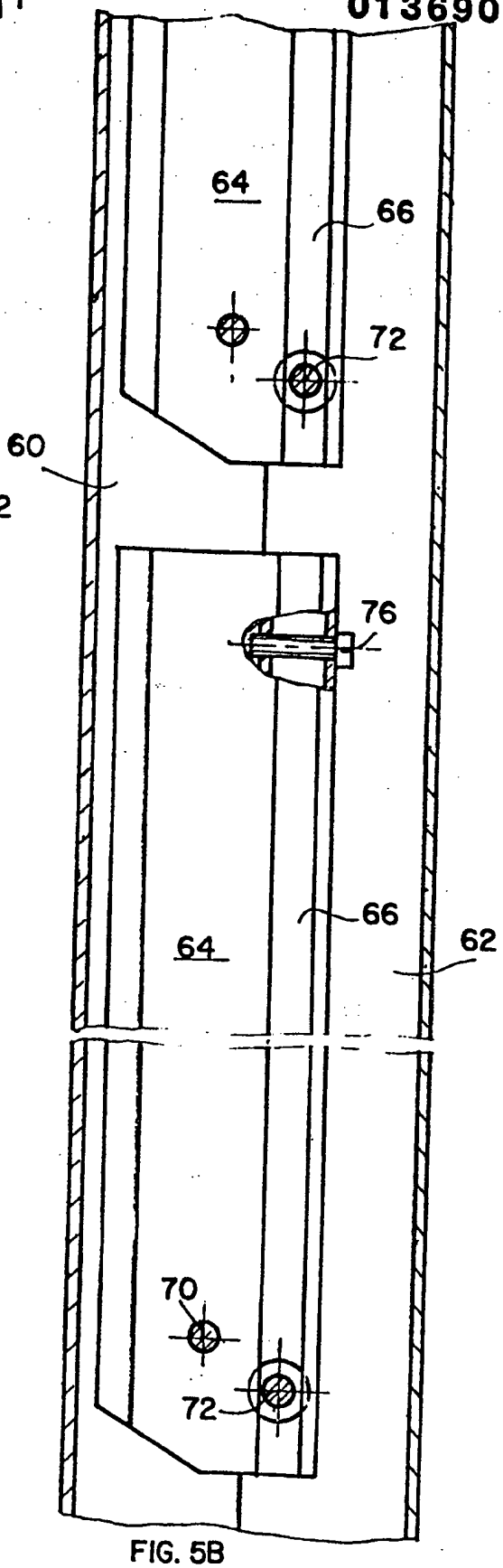

FIG. 5B

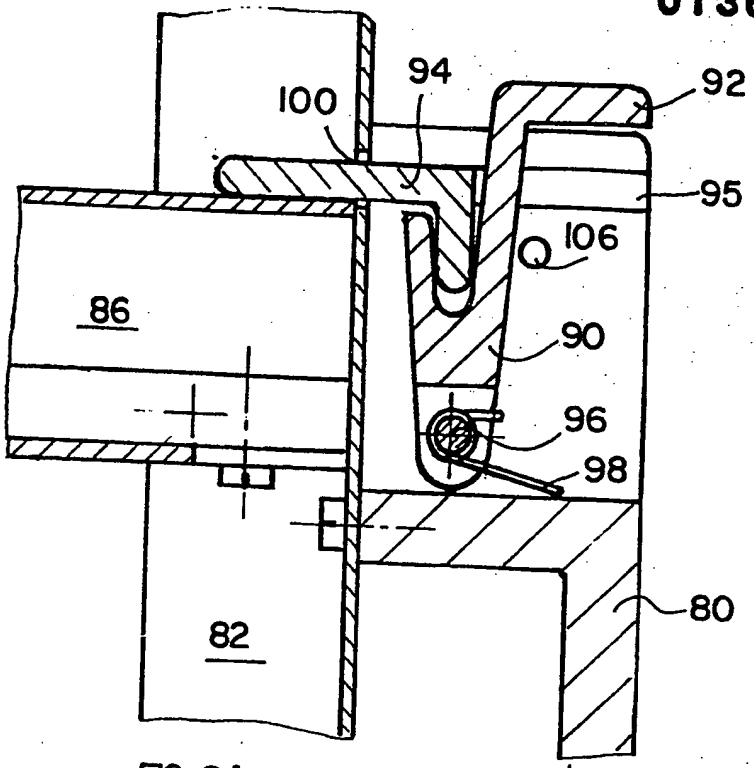
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FIG. 6A

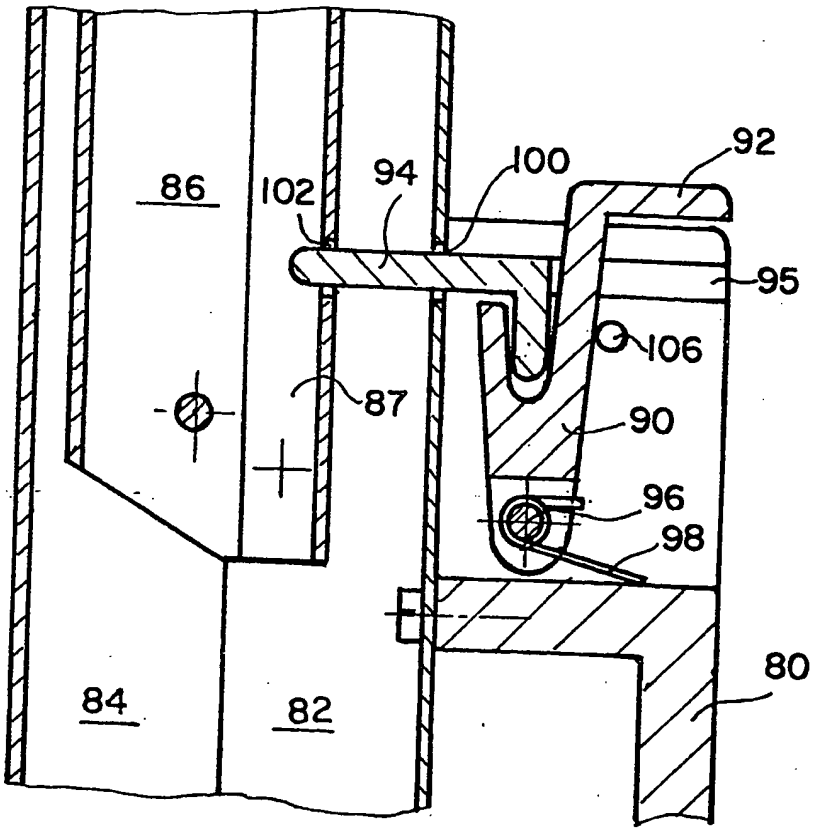
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FIG. 6B